

AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application:

Claims:

1. (Currently Amended) A method comprising:
performing an injection operation in a subterranean formation penetrated by at least one injection well and at least one production well, wherein the injection operation comprises:

introducing a water-soluble relative permeability modifier comprising a hydrophobically modified water-soluble polymer through at least one injection well into a first zone of the subterranean formation having a permeability to aqueous-based fluids so that the hydrophobically modified water-soluble polymer reduces the permeability of the first zone of the subterranean formation to aqueous-based fluids, wherein the hydrophobically modified water-soluble polymer has a molecular weight in the range of about 100,000 to about 10,000,000 once synthesized and comprises a polymer backbone and a hydrophobic branch, the hydrophobic branch comprising an organic acid derivative selected from the group consisting of: an anhydride of octenyl succinic acid, an ester of octenyl succinic acid, an amide of octenyl succinic acid, an anhydride of dodecenyl succinic acid, an ester of dodecenyl succinic acid, and an amide of dodecenyl succinic acid-alkyl group of from about 4 carbons to 22 carbons without any intervening heteroatoms; and

injecting an aqueous injection fluid through at least one injection well into the first zone of the subterranean formation after introducing the water-soluble relative permeability modifier so that the hydrophobically modified water-soluble polymer present in the first zone of the subterranean formation diverts at least a portion of the aqueous injection fluid to a second zone of the subterranean formation.

2. (Canceled)
3. (Original) The method of claim 1 wherein the hydrophobically modified water-soluble polymer comprises a polymer backbone comprising polar heteroatoms.
4. (Previously Presented) The method of claim 3 wherein the polar heteroatoms present within the polymer backbone of the hydrophobically modified water-soluble polymer

comprise at least one atom selected from the group consisting of: oxygen, sulfur, and phosphorous.

5. (Original) The method of claim 1 wherein the hydrophobically modified water-soluble polymer is a reaction product of a hydrophilic polymer and a hydrophobic compound.

6-9. (Canceled)

10. (Original) The method of claim 5 wherein the hydrophilic polymer comprises a polymer backbone comprising polar heteroatoms.

11. (Previously Presented) The method of claim 10 wherein the hydrophilic polymer comprises at least one polymer selected from the group consisting of: a cellulose, a chitosan, a polyamide, a polyetheramine, a polyethyleneimine, a polyhydroxyetheramine, a polylysine, a polysulfone, and a starch.

12. (Previously Presented) The method of claim 5 wherein the hydrophobic compound comprises at least one compound selected from the group consisting of: an alkyl halide, a sulfonate, a sulfate, and an organic acid derivative.

13. (Previously Presented) The method of claim 12 wherein the organic acid derivative comprises at least one organic acid derivative selected from the group consisting of: an octenyl succinic acid, a dodecenyl succinic acid, an anhydride of octenyl succinic acid, an ester of octenyl succinic acid, an amide of octenyl succinic acid, an anhydride of dodecenyl succinic acid, an ester of dodecenyl succinic acid, and an amide of dodecenyl succinic acid.

14. (Previously Presented) The method of claim 5 wherein the hydrophobic compound has an alkyl chain length of about 4 to about 22 carbons.

15-20. (Canceled)

21. (Original) The method of claim 1 wherein the hydrophobically modified water-soluble polymer is prepared from a polymerization reaction of at least one hydrophilic monomer and at least one hydrophobically modified hydrophilic monomer.

22-23. (Canceled)

24. (Previously Presented) The method of claim 21 wherein the mole ratio of the hydrophilic monomer to the hydrophobically modified hydrophilic monomer in the

hydrophobically modified water-soluble polymer is in the range of about 99.98:0.02 to about 90:10.

25. (Previously Presented) The method of claim 1 wherein the water-soluble relative permeability modifier is introduced into the first zone of the subterranean formation by injecting a permeability-modifying injection fluid comprising an aqueous injection fluid and the water-soluble relative permeability modifier into the first zone of the subterranean formation.

26. (Previously Presented) The method of claim 25 wherein the water-soluble relative permeability modifier is present in the permeability-modifying injection fluid in an amount in the range of about 0.02% to about 10% by weight of the permeability-modifying injection fluid.

27. (Original) The method of claim 25 wherein the permeability-modifying injection fluid was formed by metering the water-soluble relative permeability modifier into an existing injection stream comprising the aqueous injection fluid to form the permeability-modifying injection fluid.

28. (Previously Presented) The method of claim 1 wherein the water-soluble relative permeability modifier is introduced into the first zone of the subterranean formation by injecting a treatment fluid comprising the water-soluble relative permeability modifier into the first zone of the subterranean formation.

29. (Previously Presented) The method of claim 28 wherein the water-soluble relative permeability modifier is present in the treatment fluid in an amount in the range of about 0.02% to about 10% by weight of the treatment fluid.

30-99. (Canceled)

100. (Withdrawn) The method of claim 5 wherein the hydrophilic polymer comprises a dialkyl amino pendant group.

101. (Withdrawn) The method of claim 5 wherein the hydrophilic polymer comprises a dimethyl amino pendant group and at least one monomer selected from the group consisting of: dimethylaminoethyl methacrylate and dimethylaminopropyl methacrylamide.

102. (Withdrawn) The method of claim 5 wherein the hydrophilic polymer comprises at least one polymer selected from the group consisting of: a polyvinylamine, a poly(vinylamine/vinyl alcohol), and an alkyl acrylate polymer.

103. (Withdrawn) The method of claim 5 wherein the hydrophilic polymer comprises at least one polymer selected from the group consisting of: polydimethylaminoethyl methacrylate, polydimethylaminopropyl methacrylamide, poly(acrylamide/dimethylaminoethyl methacrylate), poly(acrylic acid/dimethylaminoethyl methacrylate), poly(methacrylic acid/dimethylaminoethyl methacrylate), poly(2-acrylamido-2-methyl propane sulfonic acid/dimethylaminoethyl methacrylate), poly(acrylamide/dimethylaminopropyl methacrylamide), poly(acrylic acid/dimethylaminopropyl methacrylamide), and poly(methacrylic acid/dimethylaminopropyl methacrylamide).

104. (Withdrawn) The method of claim 21 wherein the hydrophilic monomer comprises at least one monomer selected from the group consisting of: acrylamide, 2-acrylamido-2-methyl propane sulfonic acid, N,N-dimethylacrylamide, vinyl pyrrolidone, dimethylaminoethyl methacrylate, acrylic acid, dimethylaminopropylmethacrylamide, vinyl amine, vinyl acetate, trimethylammoniummethyl methacrylate chloride, methacrylamide, hydroxyethyl acrylate, vinyl sulfonic acid, vinyl phosphonic acid, methacrylic acid, vinyl caprolactam, N-vinylformamide, N,N-diallylacetamide, dimethyldiallyl ammonium halide, itaconic acid, styrene sulfonic acid, methacrylamidoethyltrimethyl ammonium halide, a quaternary salt derivative of acrylamide, and a quaternary salt derivative of acrylic acid.

105. (Withdrawn) The method of claim 21 wherein the hydrophobically modified hydrophilic monomer comprises at least one monomer selected from the group consisting of: an alkyl acrylate, an alkyl methacrylate, an alkyl acrylamide, an alkyl methacrylamide, an alkyl dimethylammoniummethyl methacrylate halide, and an alkyl dimethylammoniumpropyl methacrylamide halide, wherein the alkyl groups have from about 4 to about 22 carbon atoms.

106. (Withdrawn) A method comprising:
performing an injection operation in a subterranean formation penetrated by at least one injection well and at least one production well, wherein the injection operation comprises:

introducing a relative permeability modifier comprising a hydrophobically modified water-soluble polymer through at least one injection well into a first zone of the subterranean formation having a permeability to aqueous-based fluids, wherein the hydrophobically modified water-soluble polymer comprises a polymer backbone and an amino pendant group quaternized to include a hydrophobic branch, the hydrophobic branch comprising an alkyl group of from about 4 carbons to 22 carbons without any intervening heteroatoms, and wherein the hydrophobically modified polymer reduces the permeability of first zone of the subterranean formation to aqueous-based fluids without substantially reducing a permeability of the first zone of the subterranean formation to hydrocarbons; and

introducing an aqueous injection fluid through at least one injection well into the first zone of the subterranean formation, wherein the hydrophobically modified water-soluble polymer present in the first zone of the subterranean formation diverts at least a portion of the aqueous injection fluid to a second zone of the subterranean formation so that the aqueous injection fluid drives hydrocarbons present in the second zone of the subterranean formation to at least one production well.

107-110. (Canceled)

111. (Withdrawn) The method of claim 106 wherein the hydrophobically modified water-soluble polymer is a reaction product of a hydrophilic polymer and a hydrophobic compound.

112. (Withdrawn) The method of claim 111 wherein the hydrophilic polymer comprises a dialkyl amino pendant group.

113. (Withdrawn) The method of claim 111 wherein the hydrophilic polymer comprises a dimethyl amino pendant group and at least one monomer selected from the group consisting of: dimethylaminoethyl methacrylate and dimethylaminopropyl methacrylamide.

114. (Withdrawn) The method of claim 111 wherein the hydrophilic polymer comprises at least one polymer selected from the group consisting of: a poly(vinylamine/vinyl alcohol), and an alkyl acrylate polymer.

115. (Withdrawn) The method of claim 111 wherein the hydrophilic polymer comprises at least one polymer selected from the group consisting of: polydimethylaminoethyl

methacrylate, polydimethylaminopropyl methacrylamide, poly(acrylamide/dimethylaminoethyl methacrylate), poly(acrylic acid/dimethylaminoethyl methacrylate), poly(methacrylic acid/dimethylaminoethyl methacrylate), poly(2-acrylamido-2-methyl propane sulfonic acid/dimethylaminoethyl methacrylate), poly(acrylamide/dimethylaminopropyl methacrylamide), poly(acrylic acid/dimethylaminopropyl methacrylamide), and poly(methacrylic acid/dimethylaminopropyl methacrylamide).

116. (Withdrawn) The method of claim 111 wherein the hydrophilic polymer comprises at least one polymer selected from the group consisting of: a cellulose, a chitosan, a polyamide, a polyetheramine, a polyethyleneimine, a polyhydroxyetheramine, a polylysine, a polysulfone, and a starch.

117. (Withdrawn) The method of claim 111 wherein the hydrophobic compound comprises at least compound selected from the group consisting of: an alkyl halide, a sulfonate, a sulfate, and an organic acid derivative.

118. (Withdrawn) The method of claim 117 wherein the hydrophobic compound comprises the organic acid derivative, the organic acid derivative comprising at least organic acid derivative selected from the group consisting of: an octenyl succinic acid, a dodecenyl succinic acid, an anhydride of octenyl succinic acid, an ester of octenyl succinic acid, an amide of octenyl succinic acid, an anhydride of dodecenyl succinic acid, an ester of dodecenyl succinic acid, and an amide of dodecenyl succinic acid.

119. (Withdrawn) The method of claim 111 wherein the hydrophobic compound has an alkyl chain length of about 4 to about 22 carbons.

120. (Withdrawn) The method of claim 106 wherein the hydrophobically modified water-soluble polymer is prepared from a polymerization reaction of at least one hydrophilic monomer and at least one hydrophobically modified hydrophilic monomer.

121. (Withdrawn) The method of claim 120 wherein the hydrophilic monomer comprises at least one monomer selected from the group consisting of: acrylamide, 2-acrylamido-2-methyl propane sulfonic acid, N,N-dimethylacrylamide, vinyl pyrrolidone, dimethylaminoethyl methacrylate, acrylic acid, dimethylaminopropylmethacrylamide, vinyl amine, vinyl acetate, trimethylammoniumethyl methacrylate chloride, methacrylamide,

hydroxyethyl acrylate, vinyl sulfonic acid, vinyl phosphonic acid, methacrylic acid, vinyl caprolactam, N-vinylformamide, N,N-diallylacetamide, dimethyldiallyl ammonium halide, itaconic acid, styrene sulfonic acid, methacrylamidoethyltrimethyl ammonium halide, a quaternary salt derivative of acrylamide, and a quaternary salt derivative of acrylic acid.

122. (Withdrawn) The method of claim 120 wherein the hydrophobically modified hydrophilic monomer comprises at least one monomer selected from the group consisting of: an alkyl acrylate, an alkyl methacrylate, an alkyl acrylamide, an alkyl methacrylamide, an alkyl dimethylammoniummethyl methacrylate halide, and an alkyl dimethylammoniumpropyl methacrylamide halide, wherein the alkyl groups have from about 4 to about 22 carbon atoms.

123. (Withdrawn) The method of claim 120 wherein the mole ratio of the hydrophilic monomer to the hydrophobically modified hydrophilic monomer in the hydrophobically modified water-soluble polymer is in the range of about 99.98:0.02 to about 90:10.

124. (Withdrawn) The method of claim 106 wherein the water-soluble relative permeability modifier is introduced into the first zone of the subterranean formation by injecting a permeability-modifying injection fluid comprising an aqueous injection fluid and the water-soluble relative permeability modifier into the first zone of the subterranean formation.

125. (Withdrawn) The method of claim 124 comprising metering the water-soluble relative permeability modifier into an existing injection stream comprising the aqueous injection fluid to form the permeability-modifying injection fluid.

126. (Withdrawn) The method of claim 106 wherein the water-soluble relative permeability modifier is introduced into the first zone of the subterranean formation by injecting a treatment fluid comprising the water-soluble relative permeability modifier into the first zone of the subterranean formation.

127. (Currently Amended) A method comprising:
performing an injection operation in a subterranean formation penetrated by at least one injection well and at least one production well, the injection operation comprises:
introducing a hydrophobically modified water-soluble polymer through an injection well into a first zone of the subterranean formation having a permeability to aqueous-based fluids, wherein the hydrophobically modified water-soluble polymer has a molecular

weight in the range of about 100,000 to about 10,000,000 once synthesized, wherein the hydrophobically modified water-soluble polymer comprises a polymer backbone and a hydrophobic branch, the hydrophobic branch comprising an organic acid derivative selected from the group consisting of: an anhydride of octenyl succinic acid, an ester of octenyl succinic acid, an amide of octenyl succinic acid, an anhydride of dodecenyl succinic acid, an ester of dodecenyl succinic acid, and an amide of dodecenyl succinic acid-alkyl group of from about 4 carbons to 22 carbons without any intervening heteroatoms, and wherein the hydrophobically modified water-soluble polymer reduces the permeability of the first zone of the subterranean formation to aqueous-based fluids; and

introducing an aqueous injection fluid through an injection well into the first zone of the subterranean formation.

128-129. (Canceled)

130. (Previously Presented) The method of claim 127 wherein the hydrophobically modified water-soluble polymer comprises a polymer backbone comprising polar heteroatoms.

131. (Previously Presented) The method of claim 130 wherein the polar heteroatoms present within the polymer backbone of the hydrophobically modified water-soluble polymer comprise at least one atom selected from the group consisting of: oxygen, sulfur, and phosphorous.

132. (Previously Presented) The method of claim 127 wherein the hydrophobically modified water-soluble polymer is a reaction product of a hydrophilic polymer and a hydrophobic compound.

133. (Withdrawn) The method of claim 127 wherein the hydrophilic polymer comprises a dialkyl amino pendant group.

134. (Withdrawn) The method of claim 127 wherein the hydrophilic polymer comprises a dimethyl amino pendant group and at least one monomer selected from the group consisting of dimethylaminoethyl methacrylate and dimethylaminopropyl methacrylamide.

135. (Withdrawn) The method of claim 127 wherein the hydrophilic polymer comprises at least one polymer selected from the group consisting of: a polyvinylamine, a poly(vinylamine/vinyl alcohol), and an alkyl acrylate polymer.

136. (Withdrawn) The method of claim 127 wherein the hydrophilic polymer comprises at least one polymer selected from the group consisting of: polydimethylaminoethyl methacrylate, polydimethylaminopropyl methacrylamide, poly(acrylamide/dimethylaminoethyl methacrylate), poly(acrylic acid/dimethylaminoethyl methacrylate), poly(methacrylic acid/dimethylaminoethyl methacrylate), poly(2-acrylamido-2-methyl propane sulfonic acid/dimethylaminoethyl methacrylate), poly(acrylamide/dimethylaminopropyl methacrylamide), poly(acrylic acid/dimethylaminopropyl methacrylamide), and poly(methacrylic acid/dimethylaminopropyl methacrylamide).

137. (Previously Presented) The method of claim 132 wherein the hydrophilic polymer comprises at least one polymer selected from the group consisting of: a cellulose, a chitosan, a polyamide, a polyetheramine, a polyethyleneimine, a polyhydroxyetheramine, a polylysine, a polysulfone, and a starch.

138. (Previously Presented) The method of claim 132 wherein the hydrophobic compound comprises at least one compound selected from the group consisting of: an alkyl halide, a sulfonate, a sulfate, and an organic acid derivative.

139. (Previously Presented) The method of claim 138 wherein the hydrophobic compound comprises the organic acid derivative, the organic acid derivative comprising at least one acid derivative selected from the group consisting of: an octenyl succinic acid, a dodecenyl succinic acid, an anhydride of octenyl succinic acid, an ester of octenyl succinic acid, an amide of octenyl succinic acid, an anhydride of dodecenyl succinic acid, an ester of dodecenyl succinic acid, and an amide of dodecenyl succinic acid.

140. (Previously Presented) The method of claim 132 wherein the hydrophobic compound has an alkyl chain length of about 4 to about 22 carbons.

141. (Previously Presented) The method of claim 127 wherein the hydrophobically modified water-soluble polymer is prepared from a polymerization reaction of at least one hydrophilic monomer and at least one hydrophobically modified hydrophilic monomer.

142. (Withdrawn) The method of claim 131 wherein the hydrophilic monomer comprises at least one monomer selected from the group consisting of: acrylamide, 2-acrylamido-2-methyl propane sulfonic acid, N,N-dimethylacrylamide, vinyl pyrrolidone,

dimethylaminoethyl methacrylate, acrylic acid, dimethylaminopropylmethacrylamide, vinyl amine, vinyl acetate, trimethylammoniummethyl methacrylate chloride, methacrylamide, hydroxyethyl acrylate, vinyl sulfonic acid, vinyl phosphonic acid, methacrylic acid, vinyl caprolactam, N-vinylformamide, N,N-diallylacetamide, dimethyldiallyl ammonium halide, itaconic acid, styrene sulfonic acid, methacrylamidoethyltrimethyl ammonium halide, a quaternary salt derivative of acrylamide, and a quaternary salt derivative of acrylic acid.

143. (Withdrawn) The method of claim 141 wherein the hydrophobically modified hydrophilic monomer comprises at least one monomer selected from the group consisting of: an alkyl acrylate, an alkyl methacrylate, an alkyl acrylamide, an alkyl methacrylamide, an alkyl dimethylammoniummethyl methacrylate halide, and an alkyl dimethylammoniumpropyl methacrylamide halide, wherein the alkyl groups have from about 4 to about 22 carbon atoms.

144. (Previously Presented) The method of claim 141 wherein the mole ratio of the hydrophilic monomer to the hydrophobically modified hydrophilic monomer in the hydrophobically modified water-soluble polymer is in the range of about 99.98:0.02 to about 90:10.

145. (Previously Presented) The method of claim 127 wherein the hydrophobically modified water-soluble polymer present in the first zone of the subterranean formation diverts the aqueous injection fluid to a second zone of the subterranean formation.

146. (Canceled)

147. (Previously Presented) The method of claim 127, wherein the hydrophobically modified water-soluble polymer is water soluble.

148. (Canceled)

149. (Withdrawn) The method of claim 106, wherein the relative permeability modifier is water soluble.

150. (Withdrawn) The method of claim 1 wherein the hydrophobically modified water-soluble polymer comprises an amino pendant group quaternized to include the hydrophobic branch.

151. (Withdrawn) The method of claim 127 wherein the hydrophobically modified water-soluble polymer comprises an amino pendant group quaternized to include the hydrophobic branch.

152-154. (Canceled)

155. (Withdrawn) The method of claim 106 wherein the amino pendant group comprises a dialkyl amino pendant group.

156. (Withdrawn) The method of claim 150 wherein the amino pendant group comprises a dialkyl amino pendant group.

157. (Withdrawn) The method of claim 151 wherein the amino pendant group comprises a dialkyl amino pendant group.